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ABSTRACT

This study examined whether children (ages 6-16) diagnosed as having attention deficit disorder with hyperactivity (ADD/H) could be differentiated from those diagnosed as having attention deficit disorder without hyperactivity (ADD/WO), on an anterior-posterior gradient paradigm. It was predicted that ADD/H children (N=23) would have more deficits on tasks measuring sequential, cognitive operations and those assessing anterior or frontal lobe functioning, whereas ADD/WO children (N=19) would have more deficits on tasks measuring visual-spatial abilities and those reflecting posterior or parietal lobe functioning. No significant differences between the groups emerged across standardized and well-normed measures. Implications for testing the anterior-posterior gradient paradigm with children are discussed. (15 references) (Author/JDD)

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ANALYSIS OF THE ANTERIOR-POSTERIOR GRADIENT HYPOTHESIS AS APPLIED TO ATTENTION DEFICIT DISORDER CHILDREN

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Abstract

This study examined whether children diagnosed as ADD/H could be differentiated from those diagnosed as ADD/WO on an anterior-posterior gradient paradigm. It was predicted that ADD/H children (n=23) would have more deficits on tasks measuring sequential, cognitive operations and those assessing anterior or frontal lobe functioning, whereas ADD/WO children (n=19) would have more deficits on tasks measuring visual-spatial abilities and those reflecting posterior or parietal lobe functioning. No significant differences between the groups emerged across standardized and well-normed measures. Implications for testing the anterior-posterior gradient paradigm with children are discussed.

Analysis of the Anterior-Posterior Gradient Hypothesis as applied to Attention Deficit Disorder children

Researchers have observed that children with Attention Deficit Disorder (ADD) exhibit inappropriate behaviors in two different ways: excessive impulsiveness, which is manifested as inattention-disorganization; and a sharp decline in the tone of the nervous processes, which is seen as sluggish tempo (Luria, 1959, 1961; Schaughency & Hynd, 1989). Schaughency and Hynd (1989) speculated that children diagnosed as Attention Deficit Disorder with Hyperactivity (ADD/H) may have a disturbance in the activation system, which is modulated through the anterior frontal system, whereas children diagnosed as Attention Deficit Disorder without Hyperactivity (ADD/WO) may have a disturbance in the arousal system, which is modulated through the central-posterior region. This study examined whether subtypes of ADD children could be differentiated on an anterior-posterior gradient paradigm.

Tucker and Williamson (1984) and Tucker (1986), in an extension of Pribram and McGuinness' (1975) work, presented a model of attentional control that includes two separate neural systems: (1) an activation system that is centered in the left hemisphere, which specializes in analytic, sequential, and routinized cognitive operations such as motor responses and is modulated by dopaminergic neurotransmitters, and (2) an arousal system that is centered in the right hemisphere, which is responsible for holistic, parallel, and novel cognitive operations such as perceptual orienting responses and is modulated by norepinephrinergic neurotransmitters. Related to this perspective, Posner, Inhoff, & Fredrich (1987) posited that the parietal lobe is involved in covert shifts of visual attention whereas the frontal lobe is the attentional command system, but both work together in a complex functional system with each contributing to the attentional processes.

Evidence from neuropsychological testing indicates that children whose behavior suggests a dysfunction in their inhibitory processes respond impulsively with errors of commission to the inhibitory signals on a go-no-go paradigm task whereas children whose behavior suggests problems of the arousal system show increased latency and errors of omission (Homskaya, cited in Luria, 1959; 1961). Thus, research suggests that different types of attentional mechanisms have varying behavioral correlates, which are conceptually meaningful.

A number of researchers have documented the relation between ADD/H and anterior or frontal lobe functioning (Chelune, Ferguson, Koon, & Dickey, 1986; Luria, 1980). Specific to children, Lou, Henriksen, Bruhn, Borner, and Nielsen (1989) found that on emission CT comparisons of dysphasic, ADD/H, and control children, the ADD/H children showed hypoperfusion in the frontal lobes (i.e., anterior lobes) and hyperfusion in the primary sensory and sensorimotor regions (i.e., posterior lobes). Denkla

(1985) noted that ADD/H in children has been linked to impairments in motor functioning, which is modulated by the frontal lobes.

Likewise, links between ADD/WO and right hemisphere posterior lobe functioning have been found. Ogden (1985) found that lesions contributing most significantly to visual hemi-neglect tend to be localized to the right posterior lobe. Specific to children, Schaughency (1986) found that ADD/WO children had poorer performance than ADD/H and control children in simultaneous processing of tactile and visual sensory stimuli. Schaughency and Hynd (1989) have concluded that it seems "reasonable to tentatively postulate that an anterior-posterior gradient may well exist in the differential effects of these separate yet correlated systems with motor involvement (hyperactivity) associated with more anterior, or frontal, dysfunction and sensory deficits (inattention) manifested as a central-posterior dysfunction (pp. 438)."

In this study, it was predicted that ADD/H children would have more deficits than ADD/WO children on tasks measuring sequential, cognitive operations that are indicative of anterior or frontal lobe functioning (i.e., Trails B, Digit Span subtest of the WISC-R, and Coding subtest of the WISC-R). Conversely, it was hypothesized that ADD/WO children compared to ADD/H children would have more deficits on tasks of visual-spatial abilities that are representative of posterior or parietal lobe functioning (i.e., Beery Test of Visual-Motor Integration, Benton Line Orientation, Test of Facial Recognition, and Block Design subtest of the WISC-R). Measures were chosen to minimize their linguistic components.

The Benton Line Orientation test was scored in two ways: total correct and numbers of left-sided versus right-sided errors. The latter method is a unique way of conceptualizing and scoring this test, and can be used as a measure of hemi-inattention or visual neglect. Hemi-inattention is presumed to be caused by problems of selective attention (Heilman & Valenstein, 1985).

Method. ADD/H (n=23) and ADD/WO (n=19) groups were compared. The ADD groups included some children with a codiagnosis of Dyslexia. Children were between 6 to 16 years of age, with both sexes included and all socioeconomic levels represented. Diagnostic criteria, based on DSM-III criteria, were assessed by the K-SADS.

Results. Preliminary analyses conducted for age and IQ yielded no significant differences. One-tailed t-tests were used for age-corrected measures. Analysis of covariance (ANCOVA) was used for other measures.

On the psychometric measures, non-significant results were found on all planned comparisons of the WISC-R subtests (i.e.,

Coding and Digit Span-measures of frontal lobe functioning; Block Design-measure of parietal lobe functioning) and the Beery Tests of Visual-Motor Integration. Non-significant group effects were obtained on all visual-spatial measures.

Discussion. This study did not support the differentiation of subtypes of children diagnosed as ADD based on an anterior-posterior gradient hypothesis. Neither measures of anterior/frontal lobe functioning nor measures of posterior/parietal lobe functioning showed significant group differences. These results are similar to those of Lorys et al. (1990) who used measures with strong linguistic components.

However, on an amended version of the Judgment of Line Orientation measure, marginally significant results emerged ($p=.09$). On this measure, an error analysis of the subject's right-sided versus left-sided errors was computed. ADD/H children tended to exhibit more right-sided errors whereas ADD/WO children tended to demonstrate more left-sided errors. Results with this variation of the Judgment of Line Orientation test are in keeping with Schaughency and Hynd's (1989) postulation that ADD/H children exhibit a left frontal deficit whereas ADD/WO children exhibit a right posterior deficit.

One potential weakness of this study was that LD children were included in the groups of ADD children. Perhaps, inclusion of the LD children served to attenuate the differences in attentional dysfunction between subtypes of ADD children. In subsequent studies, researchers should consider excluding children with such codiagnoses.

The measurement of attentional processes as conceptualized on an anterior-posterior gradient paradigm in children diagnosed as ADD is challenging perhaps because their deficits are developmentally based rather than acquired. This study illustrates the necessity of using measures that minimize linguistic components and reflect subtle neurological differences in ADD children (e.g., error analysis of types of problems - errors of omission/commission or laterality, reaction time).

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ADD/H and ADD/WO Subjects
Group Means and Standard Deviations for All Measures

Test	ADD/H (n=23) X (SD)	ADD/WO (n=19) X (SD)
WISC-R		
Digit Span	9.17 (2.66)	8.58 (3.17)
Coding	7.59 (3.22)	6.90 (2.56)
Block Design	10.09 (4.08)	10.11 (3.11)
Beery Test of Visual-Motor Integration	7.18 (3.43)	7.47 (3.56)
Judgment of Line Orientation (Formula)	-0.13 (.43)	.17 (.53)
Judgment of Line Orientation (total correct)	17.68 (9.06)	16.46 (6.23)
Facial Recognition	38.83 (6.42)	39.35 (5.22)
Trails B (time)	81.39 (64.54)	72.89 (39.80)

ADD/H and ADD/WO Subjects

Group Size and Planned Comparisons Results for Measures with Age-Corrected Scores

Test	ADD/H (n)	ADD/WO (n)	t-test (1 tail)	DF	p value
WISC-R					
Digit Span	23	19	.66	40	.26
Coding	22	19	.76	39	.23
Block Design	23	19	-.02	40	.49
Beery (VMI)	22	15	-.24	35	.40

Group Size and ANCOVA Results for Each Measure with Age as a Covariate

Test	ADD/H (n)	ADD/WO (n)	df	Interaction Effect F value	Interaction Effect P value	Age Effect F	Age Effect P	Group Effect F	Group Effect P
Judgment of Line Orientation (formula)	20	13	(2,30)	.72	.40	5.48	.03	3.07	.09
Judgment of Line Orientation (# correct)	22	13	(2,33)	.46	.50	15.31	.00	.15	.70
Facial Recognition	23	17	(2,37)	.43	.52	9.81	.00	.10	.75
Trails B	23	18	(2,38)	.46	.50	19.83	.00	.22	.64

Group Size and ANCOVA Results for Each Measure with IQ as a Covariate

Test	ADD/H (n)	ADD/WO (n)	df	Interaction Effect F value	Interaction Effect P value	Age Effect F	Age Effect P	Group Effect F	Group Effect P
Trails B	14	8	(3,18)	.20	.66	5.28	.03	.32	.58

* p <.05